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(54) Transmission system for fully-tracked vehicles

(57) A transmission system for fully-tracked vehicles which has a hydrodynamic torque converter (3) arranged directly at the transmission drive input and superposed steering gears (26, 27) arranged on the driven shafts has a turbine shaft (4) of the hydrodynamic torque converter arranged below or above a main transmission shaft (14) and crossing it, with spur gear means (5, 6, 7) and bevel gear means (8, 9, 10, 11) arranged at the opposite end of the turbine shaft to the hydrodynamic converter drivingly connecting the turbine shaft (4) to the primary side components (12, 13) of reversing clutches (16, 17) arranged on a hollow shaft (15) mounted concentrically about the main shaft (14). Two-ratio planetary gear sets (28, 29) are interposed between the shaft (15) and the steering gears (26, 27), and the latter are controlled by shafts (23, 24) driven from the torque converter through means (25) such as an infinitely variable transmission.

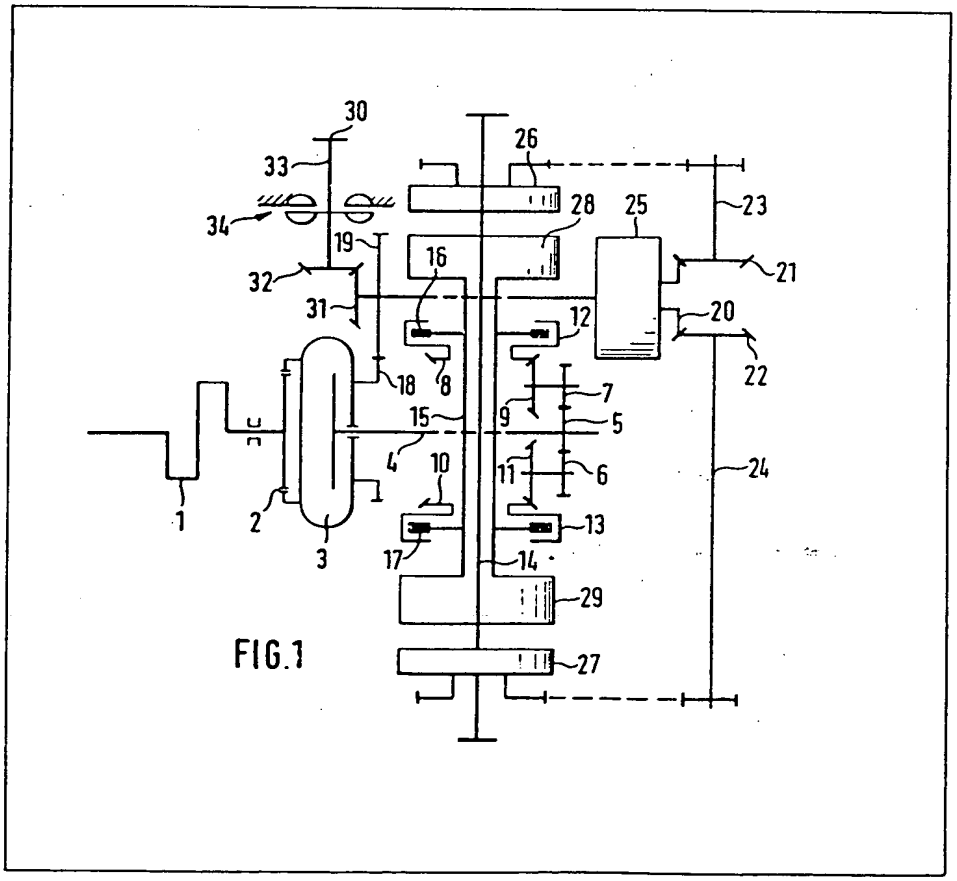

FIG.1

Fig. 5 of the drawings originally filed was informal and the print here reproduced is taken from a later filed formal copy.

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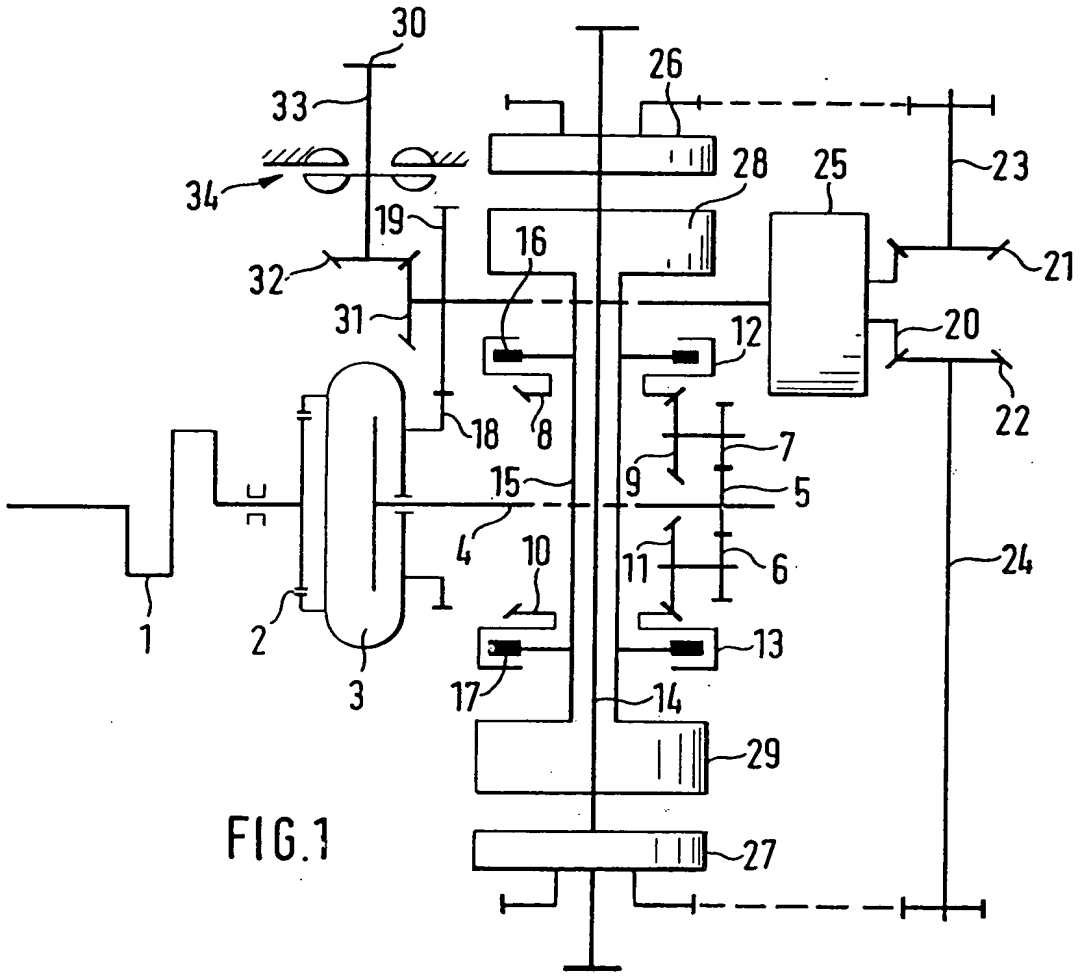

FIG.1

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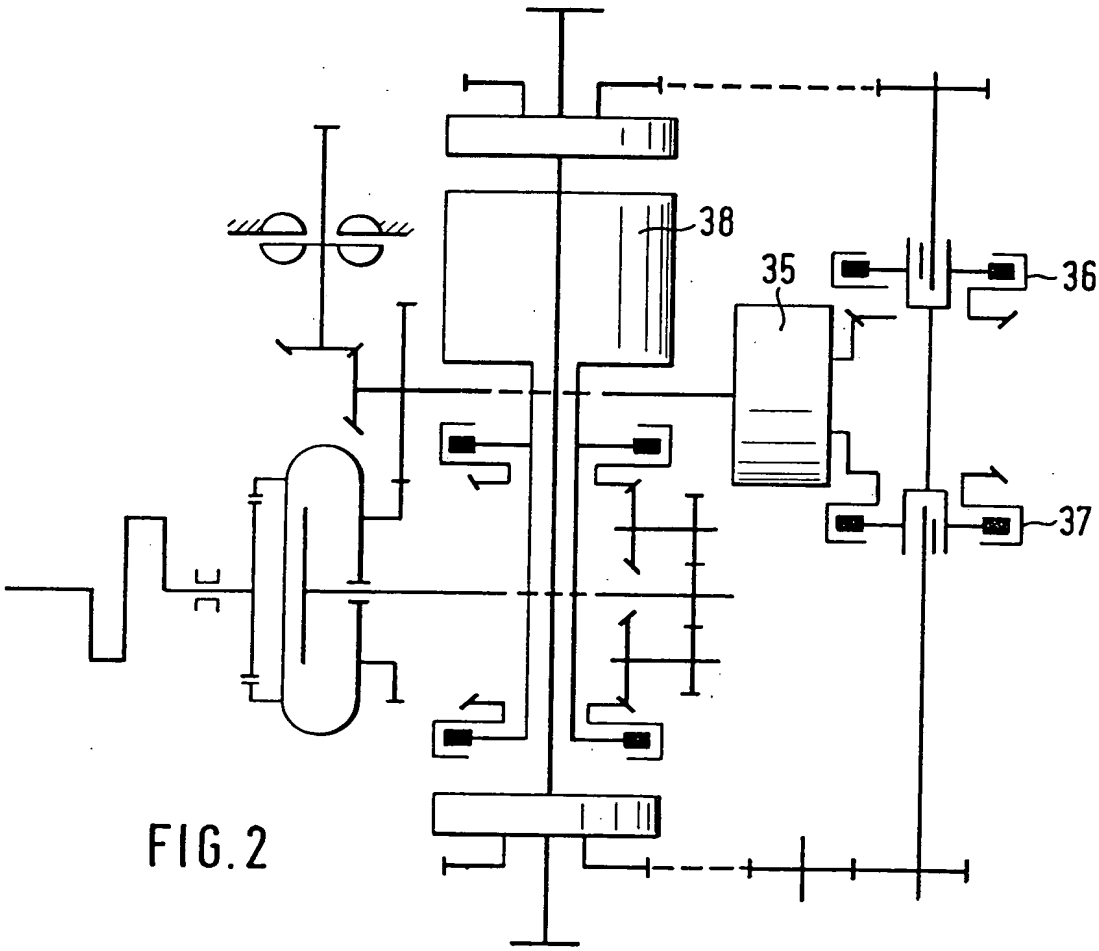

FIG.2

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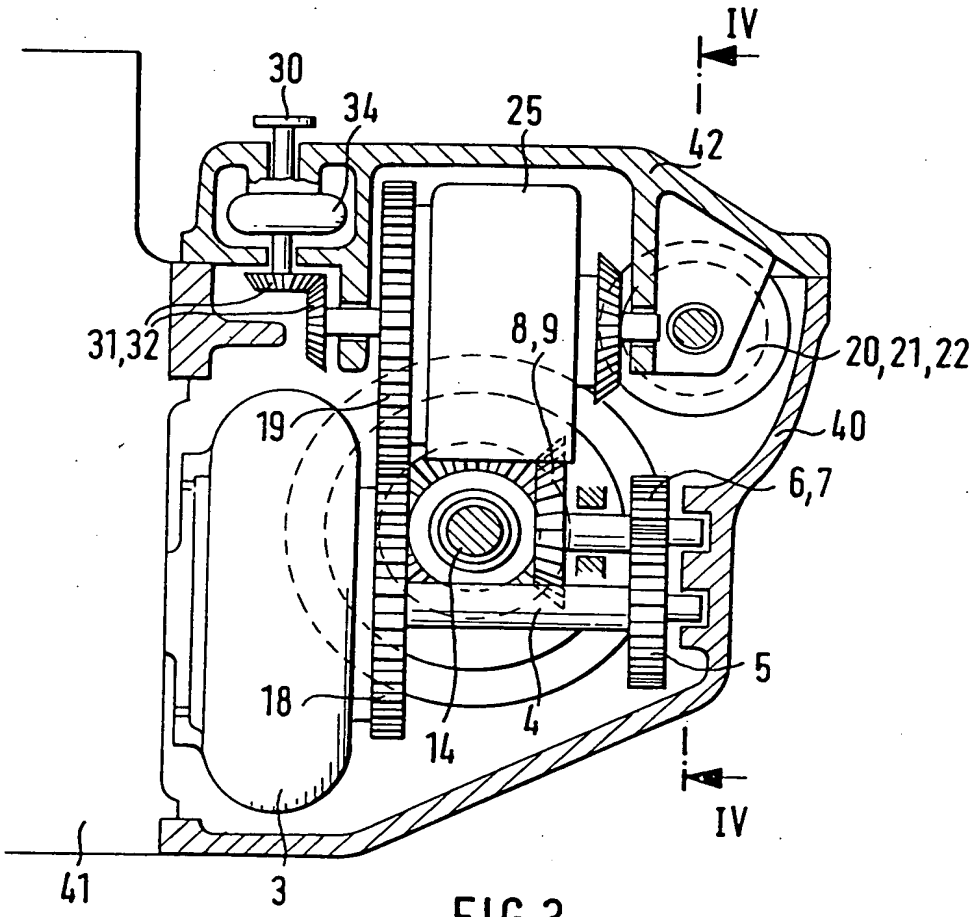

FIG.3

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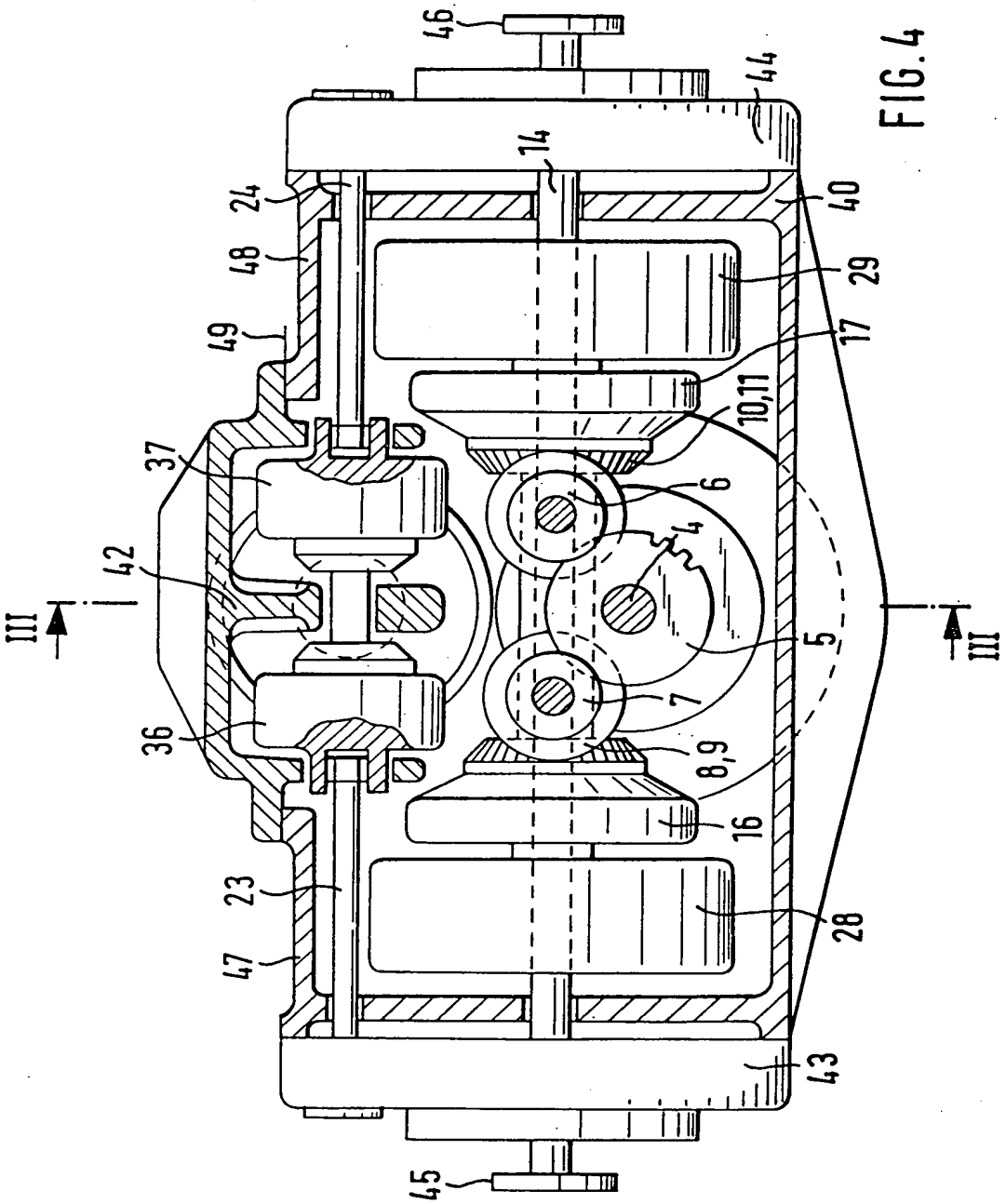

FIG.4

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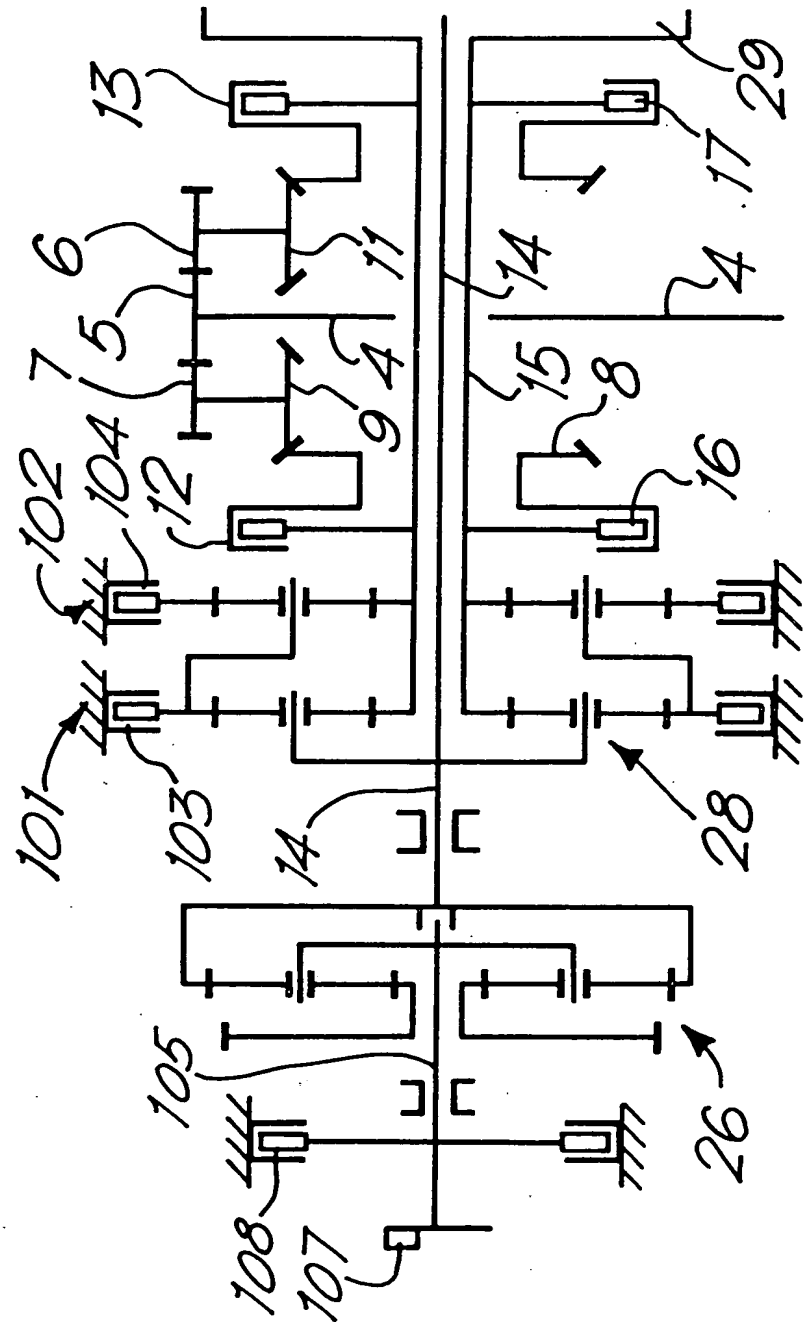

FIG.5.

SPECIFICATION

Transmission system for fully-tracked vehicles

This invention relates to a transmission system for the drive of fully-tracked vehicles having driven shafts extending transversely to the drive motor, the system comprising a hydrodynamic torque converter positioned at the transmission input, drive reversing means, speed-change means, and superposed steering gear means with superposed planetary gears arranged on the driven shafts.

Until now, known transmission systems with driven shafts lying transversely to the drive and with a hydrodynamic converter positioned immediately at the transmission input, i.e. on the drive motor, have had the disadvantage that the longitudinal distance between the motor connection and the centre of the driven transmission shafts is relatively large because of the bevel gear drive arranged in the same plane between the converter and the main transmission shaft. This distance dimension is an important factor in determining the length which is necessary for the transmission chamber and consequently in determining the length of the vehicle, the weight of the vehicle and the manufacturing costs.

Therefore, other drives have been built in which, in order to achieve a short structural length, the hydrodynamic converter is not mounted on the transmission drive, but on the main shaft which lies perpendicular to this. However, such transmission systems have the disadvantage that spur gears are necessary between the driving motor and the converter, which gear wheels, particularly in drive systems with piston-drive motors, are subjected to very severe oscillatory loads and consequently have to be correspondingly strong and heavy or else have to be protected against damage by the inclusion of additional means, for example resilient oscillation-damping clutches, which again has a negative effect on attempts to decrease the space needed, the weight and the manufacturing costs.

It is therefore an object of the present invention to avoid the aforementioned disadvantages present in the known transmission systems and to produce a transmission system which is extremely short, which is easy to build, and which has a hydrodynamic converter arranged directly at the transmission input. The system is utilisable and loadable in just the same way for both forward and reverse motion, is adaptable for different modes of use, and is equipped with a superposed steering drive. It can also be provided with an auxiliary output drive, a fluid brake and with friction brakes.

This is achieved in accordance with the invention by a transmission system for fully-tracked vehicles having driven output shafts extending transversely to the input drive axis, the system comprising a hydrodynamic torque converter arranged directly at the transmission drive input, drive reversing means, speed-change means, and superposed steering gear means having superposed steering gears arranged on the driven output shafts, in which a turbine shaft of the hydrodynamic torque converter is arranged below or above a main transmission shaft and crosses it, and spur gear means and bevel gear means, the latter serving additionally as part of the drive reversing means, are arranged at the opposite end of the turbine shaft to the hydrodynamic converter and drivingly connect the turbine shaft to the primary side components of reversible clutch means which form part of the drive reversing means and which are arranged on a hollow shaft mounted concentrically about the main shaft of the transmission system.

This novel transmission arrangement enables one to achieve an extremely short length system which is easy to build and in which the hydrodynamic converter can be used simultaneously both as a flywheel mass for the engine and also for the damping of oscillations, and in which the drive reversing means can be used in exactly the same manner in both directions of drive in respect of its ability to withstand loads and in respect of its durability.

Preferably, the steering gear means comprises a single-radius, a multiple-radius or a stepless, i.e. infinitely variable, steering unit which is arranged spatially above the turbine shaft and the main transmission shaft within a space enclosed partially by the hydrodynamic torque converter and the reversible clutch means, the steering unit, together with an upper housing portion, forming a unit which can be removed from above and which is replaceable. The steering gear means can be drivingly connected on the driving side by way of spur gears to the primary part of the torque converter and on the driven side by way of bevel gears, e.g. a bevel gear drilling set, and by way of zero shaft parts formed as detachable shafts, to the superposed steering gears. The parting line or joint between the lower and upper parts of the housing is preferably so positioned that the zero shaft parts can be arranged within the lower part of the housing.

By arranging the structural components of the speed-change means, which preferably comprises planetary gears, to the left and/or to the right between the reversible clutch means and the steering differential, it is possible to achieve either a symmetrical or an asymmetrical (T or L) structural shape for the transmission system, and consequently to achieve an optimum adaptation of the shape to the inbuilt conditions in the vehicle.

The system preferably includes an auxiliary output drive which is arranged spatially above the hydrodynamic converter with a vertically mounted shaft which serves additionally as a rotor shaft for a fluid brake. The motive connection to the transmission drive system is effected by way of a bevel gear and the primary side spur gears for the superposed steering gear means.

In order that the invention may be fully understood, a number of embodiments in accordance with the invention will now be

described by way of example and with reference to the accompanying drawings, in which:

Fig. 1 is a schematic illustration of a first embodiment of transmission system in accordance with the invention;

Fig. 2 is a schematic illustration of a second, modified embodiment of transmission system in accordance with the present invention;

Fig. 3 shows the spatial arrangement of the structural components of the transmission system of Fig. 1, the view being perpendicular to the main transmission shaft and along a section line equivalent to the line III—III in Fig. 4;

Fig. 4 shows the spatial arrangement of the structural components of a transmission system which includes features of both the embodiments shown in Figs. 1 and 2, the view being taken along a section line equivalent to the line IV—IV in Fig. 3; and

Fig. 5 schematically illustrates, in greater detail, the planetary gearing for the speed-change gearing, and their connections to the shafts.

Referring first to Figure 1, this shows a hydrodynamic converter 3 connected directly to a driving motor crankshaft 1 by means of a gear coupling 2 which is stiff against torsion. The hydrodynamic converter 3 may also be fitted with a mechanical bridging clutch. A turbine shaft 4 of the converter 3 is drivingly connected by way of spur gears 5, 6 and 7 and by way of two bevel gear sets 8, 9, 10, 11 to the primary parts 12 and 13 of a pair of reversible clutches 16 and 17 which are arranged on a hollow shaft 15 which is mounted concentrically around a main transmission shaft 14. A steering drive system 25, formed for example as an infinitely variable transmission system, is drivingly connected by way of spur gears 18 and 19 to the primary part of the converter 3 and by way of a bevel gear drilling set 20, 21 and 22 to zero shaft elements 23 and 24 which are formed as detachable shafts. Speed-change gear elements 28 and 29 and provided for the left side and/or for the right side between the reversible clutches 16 and 17 and superposed planetary gears 26 and 27. An auxiliary output drive 30 is connected to the transmission drive system by way of bevel gears 31 and 32 and the spur gears 18 and 19, and it includes a shaft 33 which serves as a rotor shaft for a fluid brake 34. The auxiliary output drive can be used to drive auxiliary devices such as a hydraulic pump or cooling fans. In known gear systems the fluid brakes, such as brake 34, are located on the main shaft, such as shaft 14. However, with such an arrangement, the lower the main shaft speed, the smaller is the braking effect. This means that one can only achieve a strong braking effect when the vehicle is moving fast. Hence, relatively large fluid brakes are needed. On the other hand, by locating the fluid brake 34 in such a way that the fluid brake is driven by the input side of the gear system, i.e. directly from the crankshaft 1, the fluid brake is always driven at a relatively high speed. The fluid brake 34 is not the main brake of the vehicle, but is intended for use for example when descending a hill. By connecting the fluid brake 34 in this way one also achieves the advantage that the braking effect of the engine is used for the deceleration of the vehicle.

The embodiment shown in Figure 2 is a variation of the transmission system shown in Figure 1. Here, the steering drive is illustrated as a double-radius superposed steering gear system having a primary side driving unit 35 and a secondary side unit formed by two clutches 36 and 37 arranged at the centre of the zero shaft. Moreover, in contrast to the embodiment shown in Figure 1, the speed-change gear 38 is here arranged completely on one side of the transmission, for example for an asymmetric transmission system.

A comparison of Figures 1 and 2 shows that the novel transmission system of the present invention is capable of being embodied in various different types of system.

Fig. 5 shows more details of some of the gearing in the transmission system. It includes the planetary gears 26, the planetary speed-change gears 28, and their connections with the main shaft 14 and the hollow shaft 15. The superposed gears 27 and speed-change gears 29 may have the same construction as the planetary gears 26 and 28 respectively. The speed-change gearing 28 includes a gear element 101 for a lower speed and a gear element 102 for a higher speed. The choice of gear element, i.e. speed, is determined by engagement of one of two clutches 103 and 104 associated with the respective gear elements.

The superposed planetary gear set 26 is driven by the main shaft 14. An output shaft 105 of the gear set 26 drives a sprocket wheel 107 for one of the vehicle tracks. A multi-disc brake 108 is also provided on the output shaft 105.

Figure 3 shows the spatial arrangement of structural components of the transmission system of Figure 1, these being shown in longitudinal section taken through the centre of the transmission system (for the section line see Figure 4). Figure 3 shows the lower portion 40 of the housing; the converter 3 coupled directly to the driving motor 41; the main transmission shaft 14 arranged adjacent to the converter 3; the turbine shaft 4 positioned beneath the main transmission shaft 14; the spur gears 5, 6 and 7 arranged at the end of the turbine shaft remote from the converter 3; and also the bevel gear set 8, 9. Also visible is the steering drive system 25 which is arranged in the space partially enclosed by the converter 3 and the reversible clutches 16 and 17 (see Figure 1). The steering drive system 25, together with the upper portion 42 of the housing, forms a removable unit which can be withdrawn from above. Also shown are the driving pinions 18 and 19, and the driven-side bevel gear set 20, 21, 22. Figure 3 also shows the auxiliary drive 30 which is positioned above the torque converter 3 and whose vertical shaft acts as a rotor shaft for the fluid brake 34. The auxiliary drive is driven by way of bevel gear set 31, 32 and the spur gears 18 and 19.

Figure 4 shows the spatial arrangement of structural components of a transmission system embodying features of Figure 1 and Figure 2, the view being a cross-sectional view taken along a section line equivalent to the section line shown in Figure 3. Figure 4 shows the lower portion 40 of the housing; transmission side units 43 and 44 which include the superposed planetary gears; two transmission take-off shafts 45 and 46; and the arrangement of the reversing gear system comprising the spur gears 5, 6 and 7, the bevel gears 8, 9, 10 and 11 and the reversible clutches 16 and 17. Also visible are the speed-change gear units 28 and 29, the turbine shaft 4, the main transmission shaft 14, the upper portion 42 of the housing with the clutches 36 and 37 (refer here also to Figure 2) arranged at the central portion of the zero shaft, and also the zero shaft parts 23 and 24 which are formed as detachable shafts and are arranged beneath the upper housing walls 47 and 48 and below the parting line 49 between the upper and lower parts of the housing.

CLAIMS

1. A transmission system for fully-tracked vehicles having driven output shafts extending transversely to the input drive axis, the system comprising a hydrodynamic torque converter arranged directly at the transmission drive input, drive reversing means, speed-change means, and superposed steering gear means having superposed steering gears arranged on the driven output shafts, in which a turbine shaft of the hydrodynamic torque converter is arranged below or above a main transmission shaft and crosses it, and spur gear means and bevel gear means, the latter serving additionally as part of the drive reversing means, are arranged at the opposite end of the turbine shaft to the hydrodynamic converter and drivingly connect the turbine shaft to the primary side components of reversible clutch means which form part of the drive reversing means and which are arranged on a hollow shaft mounted concentrically about the main shaft of the transmission system.

2. A transmission system as claimed in claim 1, in which said steering gear means comprises a single-radius, multiple-radius or infinitely variable steering unit which is arranged spatially above the main transmission shaft and above the turbine shaft within a space enclosed partially by the torque converter and the reversible clutch means, and in which said steering unit forms a removable unit with a housing cover positioned above it.

3. A transmission system as claimed in claim 2, in which the steering gear means is drivingly connected on the driving side by way of spur gears to the primary part of the torque converter and on the driven side by way of bevel gears and by way of zero shaft elements formed as detachable shafts to the superposed steering gears.

4. A transmission system as claimed in any preceding claim arranged within a housing having upper and lower parts, in which the parting line between the upper and lower parts of the housing lies sufficiently far above the centre of a zero shaft forming part of the superposed steering gear means that the zero shaft can be positioned beneath the upper housing wall of the lower portion of the housing.

5. A transmission system as claimed in any preceding claim, in which the speed-change means comprises planetary gearing, is arranged to the left and/or to the right between the reversible clutch means and the superposed steering gears, and is drivingly connected by way of the hollow shaft to the secondary side of the reversible clutch means and by way of the main transmission shaft to the superposed steering gears.

6. A transmission system as claimed in any preceding claim, which includes an auxiliary drive output arranged spatially above the hydrodynamic converter and having a vertically mounted driven shaft which serves additionally as a rotor shaft for a hydraulic fluid brake, said vertically mounted driven shaft being connected to the main motor drive by way of bevel gearing and the primary-side gears of the superposed steering gear means.

7. A transmission system for fully-tracked vehicles substantially as hereinbefore described with reference to Figs. 1, 3 and 5 or Fig. 2 or Fig. 4 of the accompanying drawings.

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